

Rapid Field Calculations for Estimating Environmental Sensitivities

M. Siderius and M. Porter
SAIC, San Diego, CA

→ Is our knowledge of the environment good enough to:

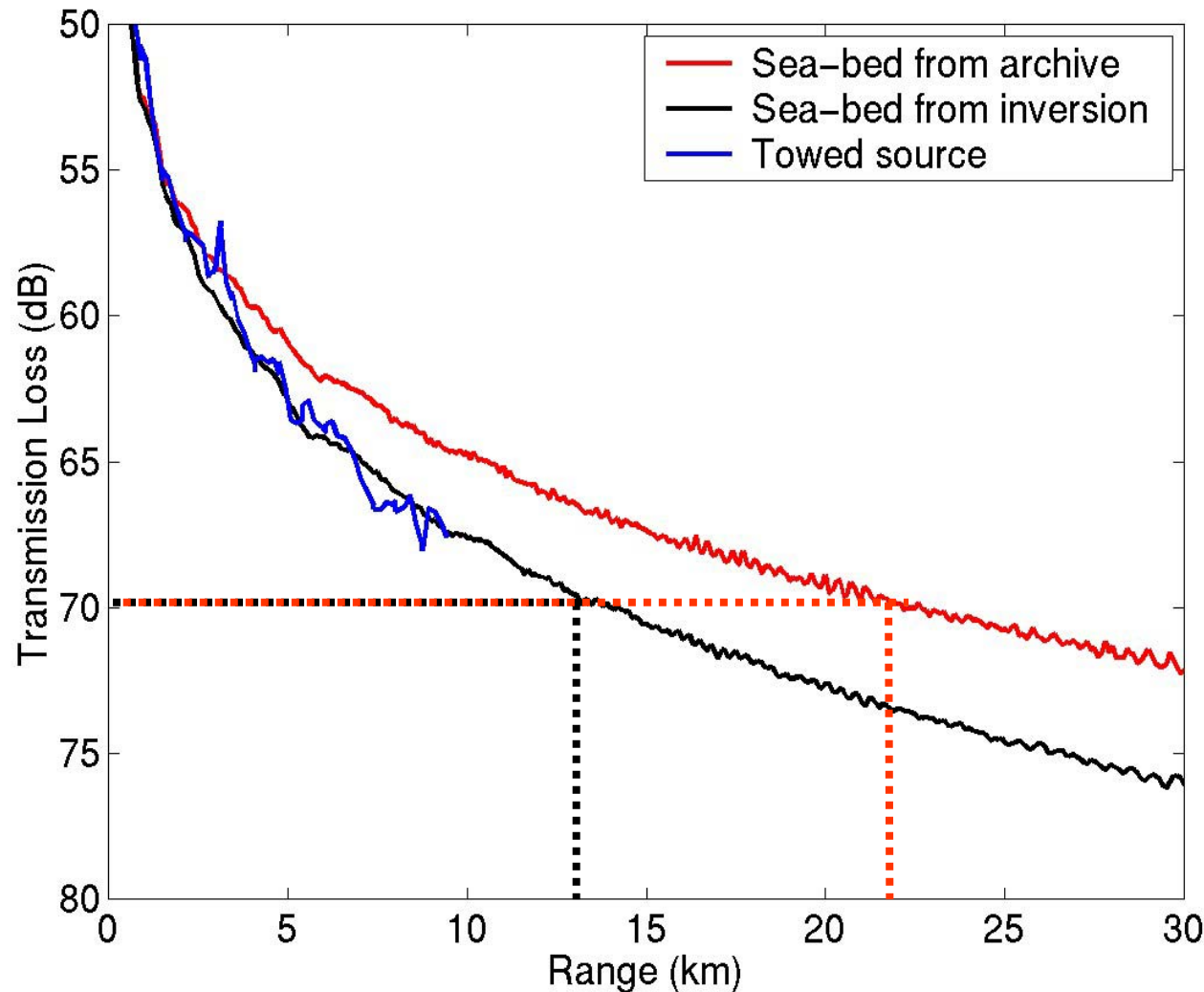
Make use of calculated TL? (e.g. sonar equation, range-of-the-day)

Perform matched field processing?

→ How well do we need to know the environment and what errors result?

We need a tool to help make a Yes/No decision for using environmentally dependent processing.

Example from the Strait of Sicily

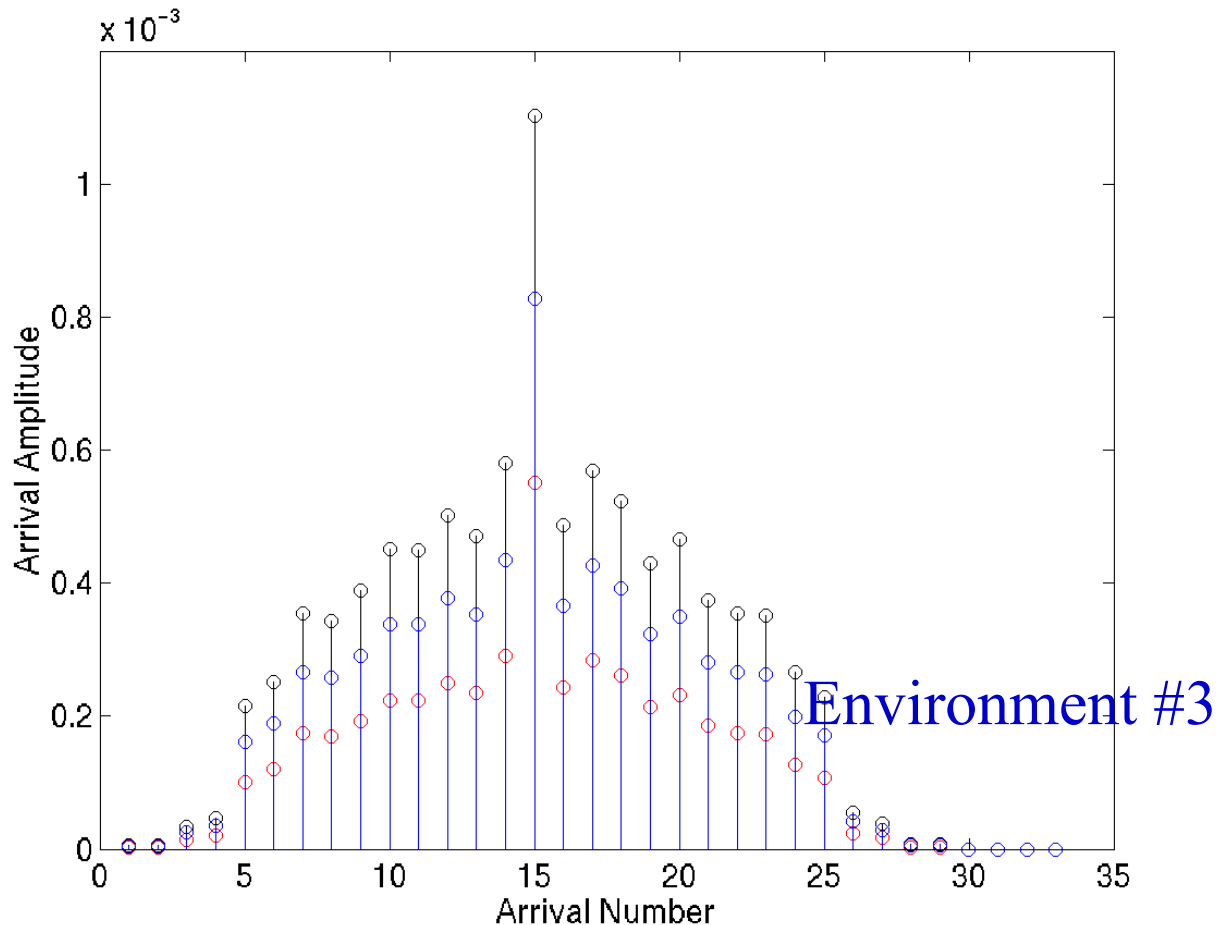


Estimating Sensitivity

- Need to compute pressure fields over the unknown parameter space.
- Resulting sensitivities will help determine if (for example):
 - An XBT should be taken
 - An *in-situ* estimate for seabed properties is required
 - High resolution bathymetry data is needed
 - Better AEL is needed

The key is to rapidly compute pressure fields to sample the *enormous*, unknown parameter space (e.g. environment).

Environmental Endpoints: Ray/beam tracing formulation



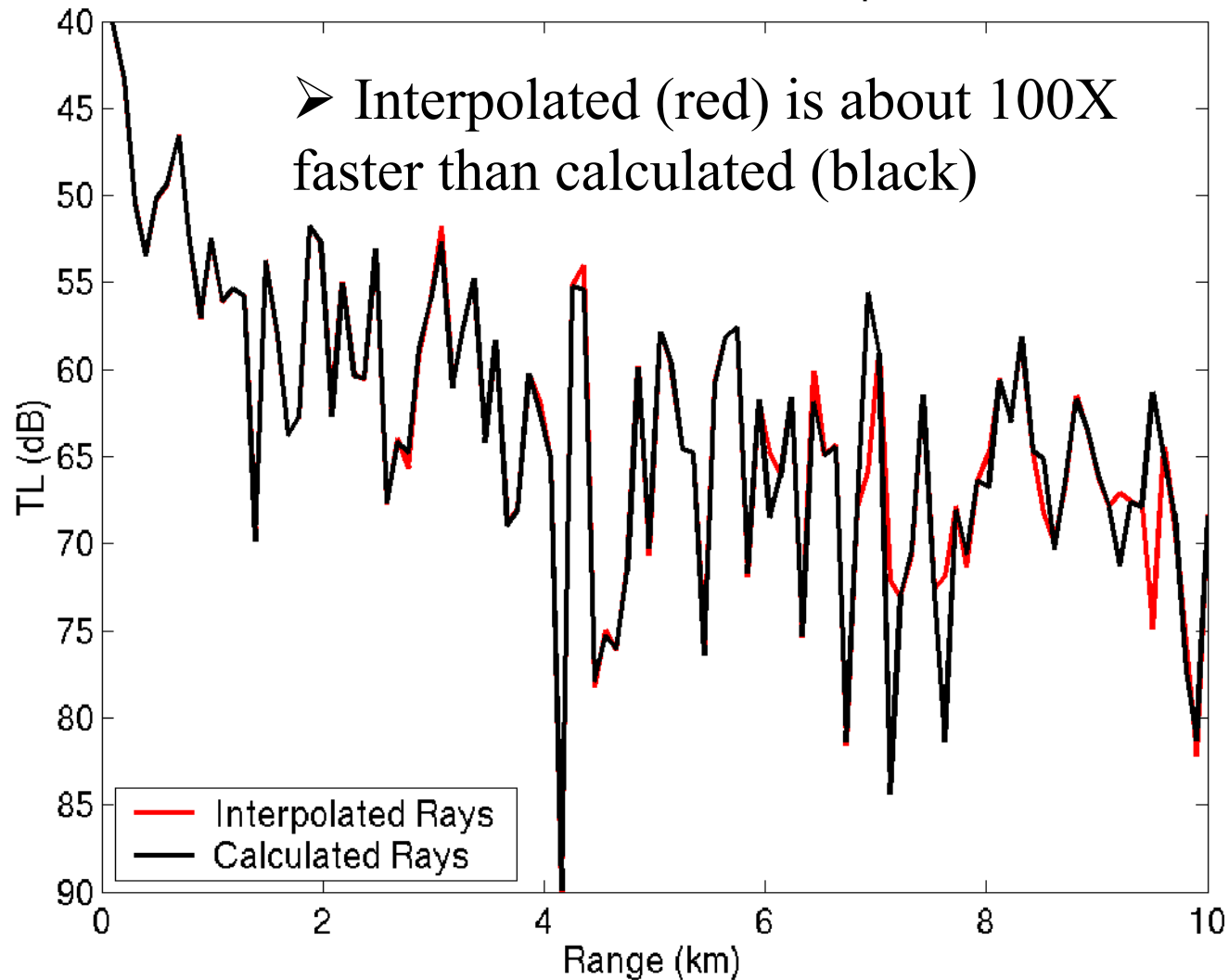
Advantage: very fast and broadband

Does it work? TL example

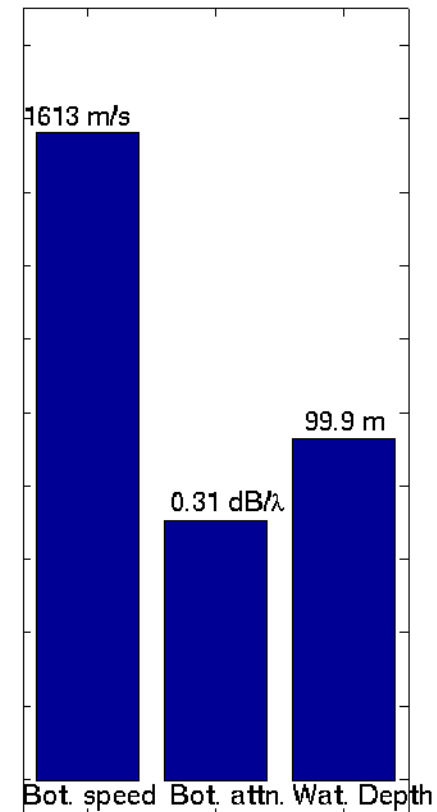
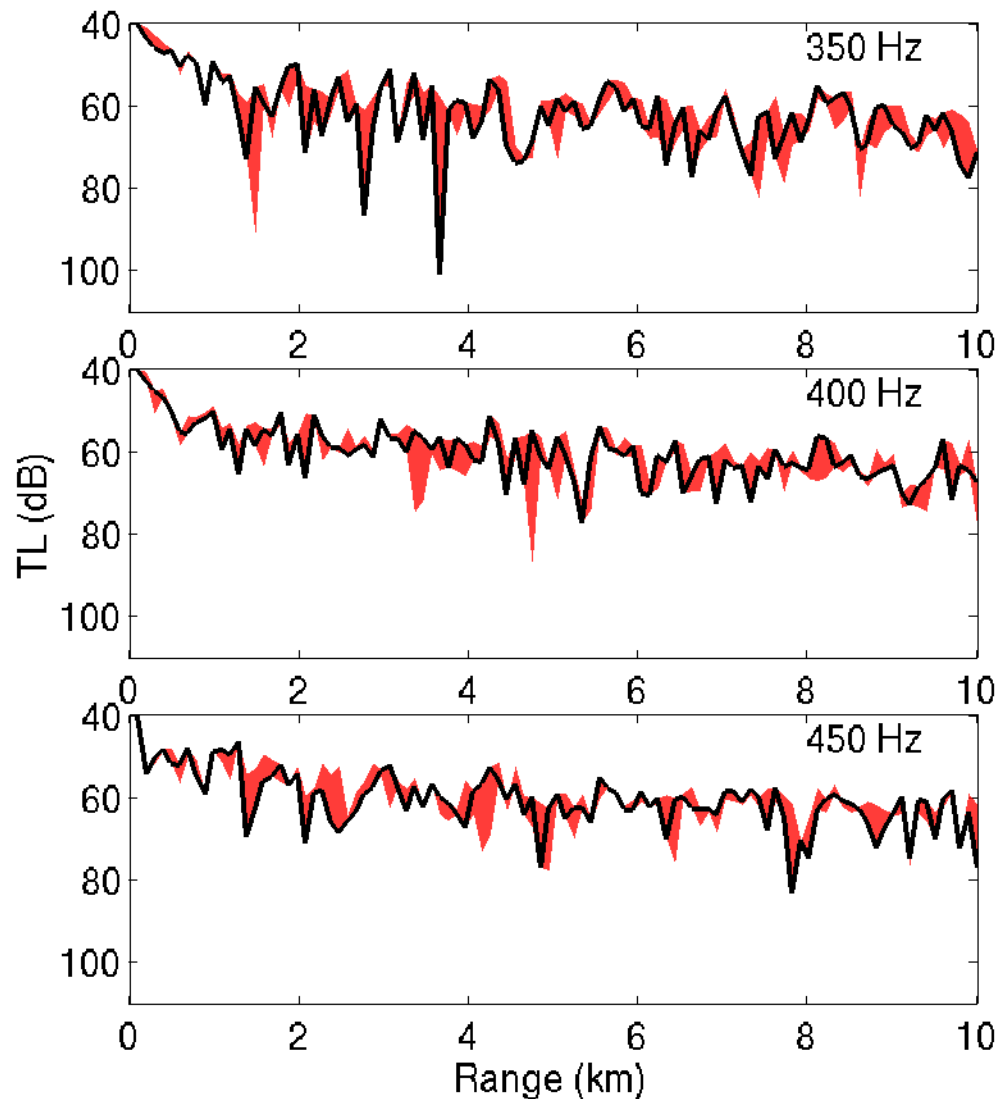
- 100-m shallow water test case:
 - Source depth 40-m
 - Receiver depth 40-m
 - Downward refracting sound speed profile
 - 350 Hz
- 3 parameters with uncertainty:
 - Sediment sound speed 1525-1625 m/s
 - Sediment attenuation 0.2-0.7 dB/ λ
 - Water depth 99-101 m

Does it work? TL example

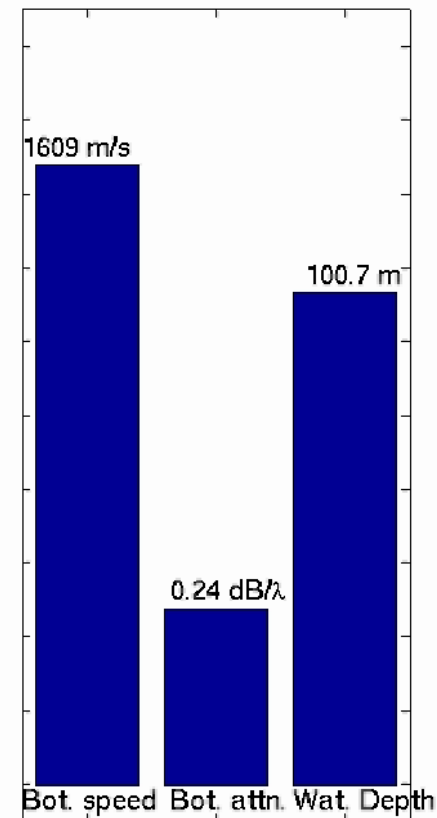
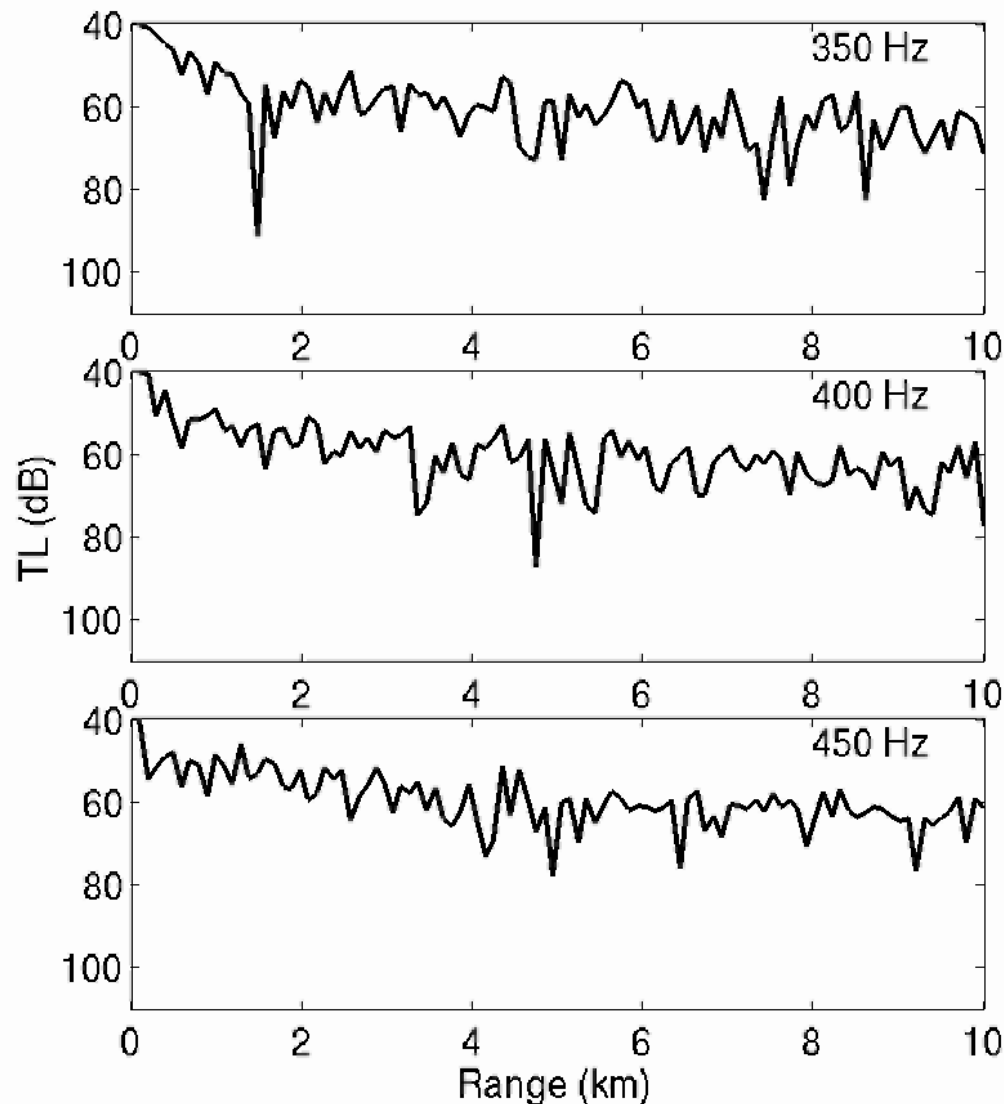
Sed. ss = 1576 m/s Attn = 0.48 dB/ λ Depth = 99.2 m



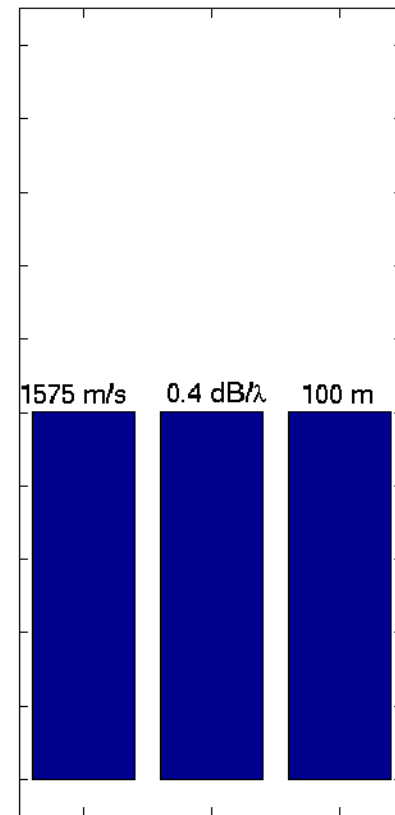
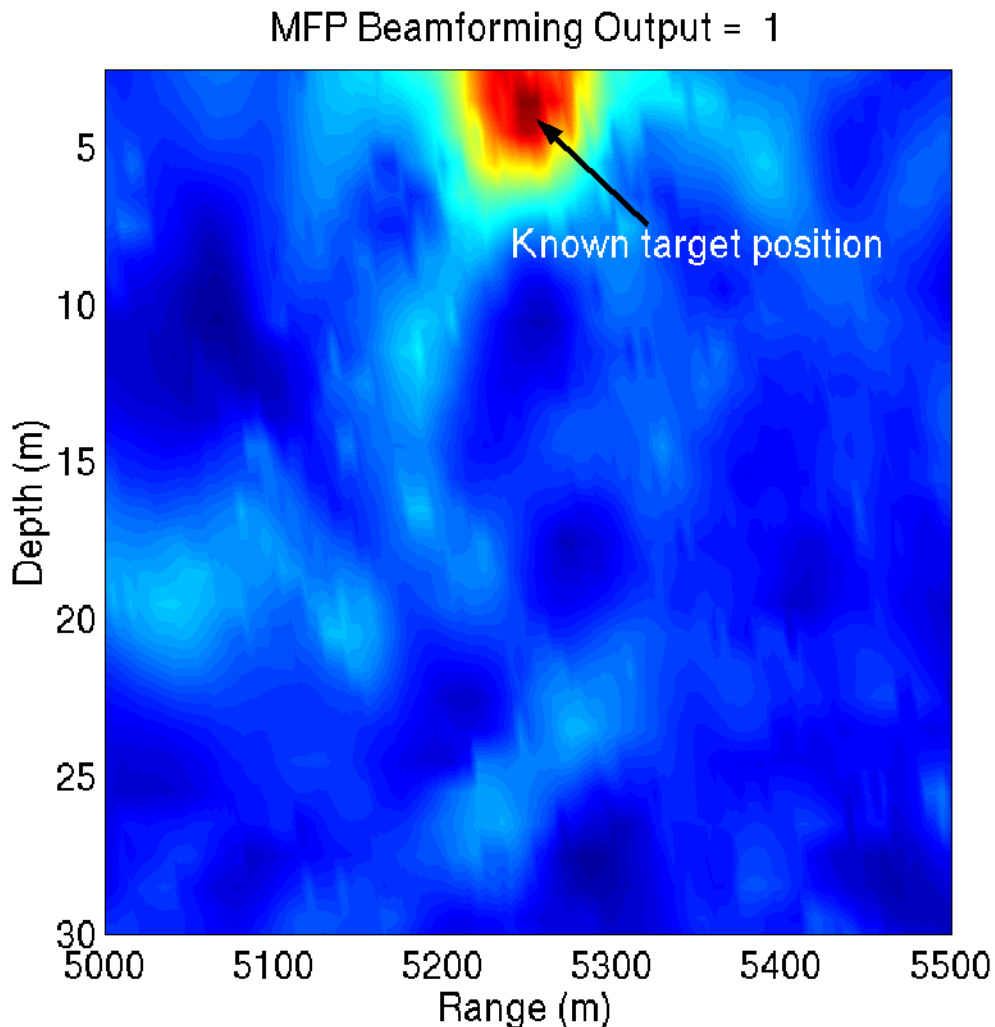
Rapid TL Uncertainty



Rapid TL Uncertainty



Environmental Focusing (Conceptual)



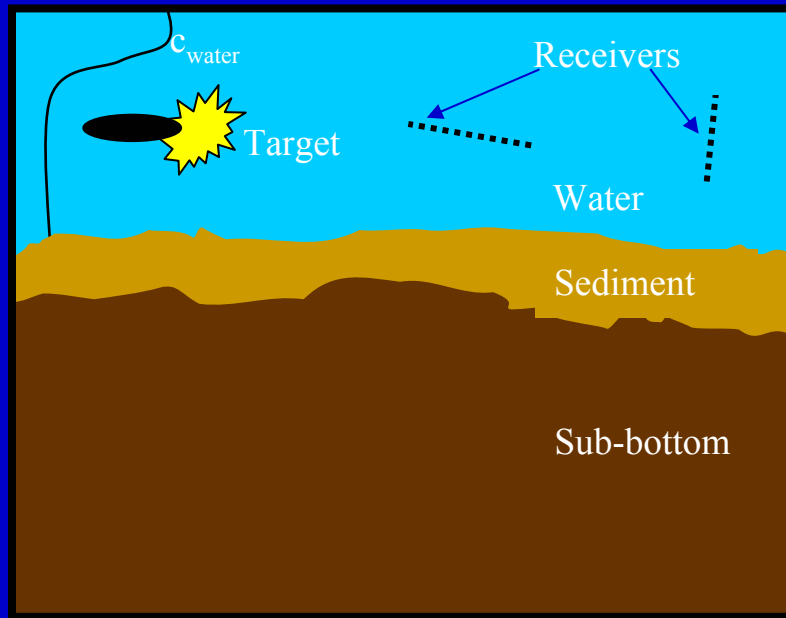
Conclusions

- Estimating uncertainty requires sampling an enormous parameter space
- The key is to have rapid, broad-band calculations
- Ray arrival amplitudes and delays are well behaved (linear) for reasonable parameter bounds
- Environmental endpoint interpolation appears to be a rapid way to compute pressure fields

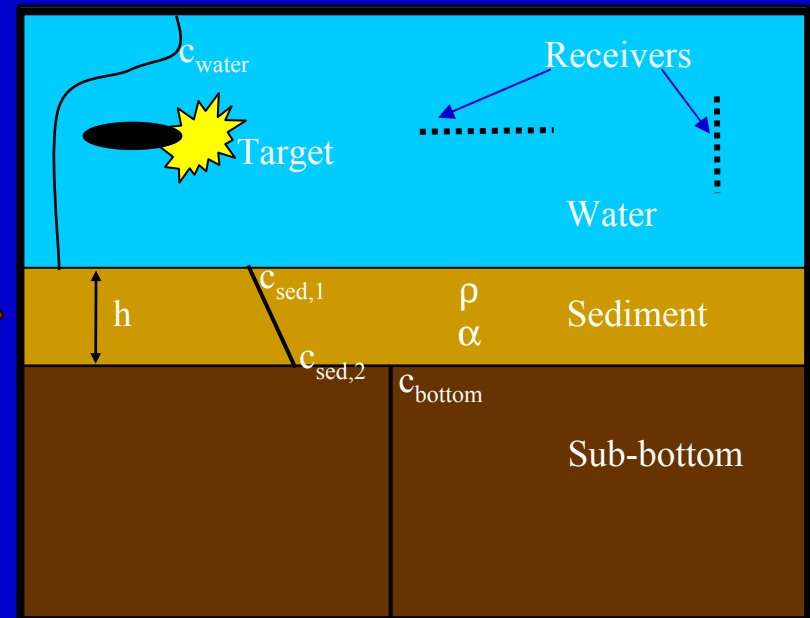
Matched Field Sensitivity

MFP Uncertainty

Real environment

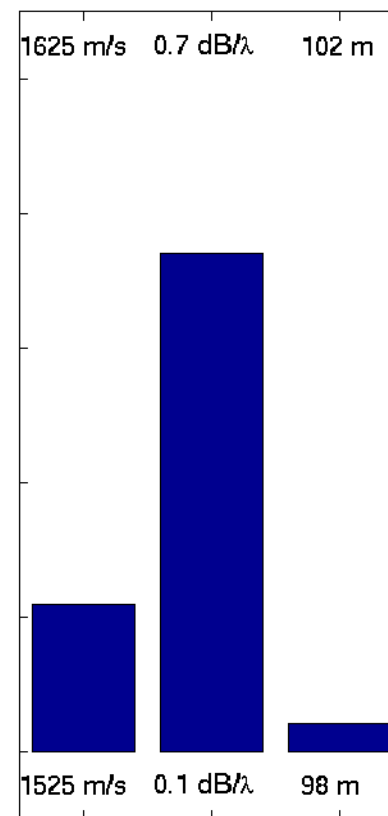
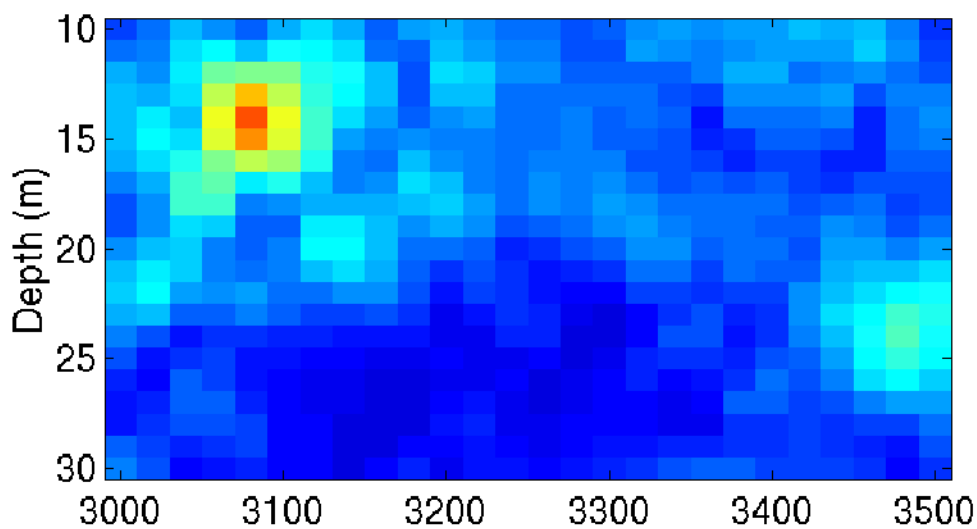
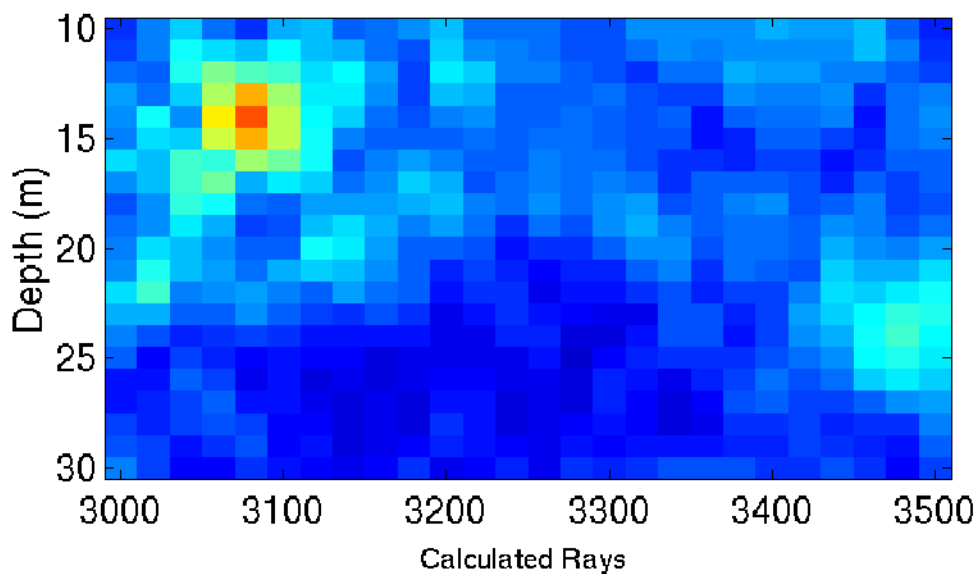


Parameterized environment



- Parameterize the environment and array
- Generate MFP ambiguity surfaces for many parameter realizations
- Generate statistics on, for example, source location, sidelobes, background level etc.

Interpolated Rays



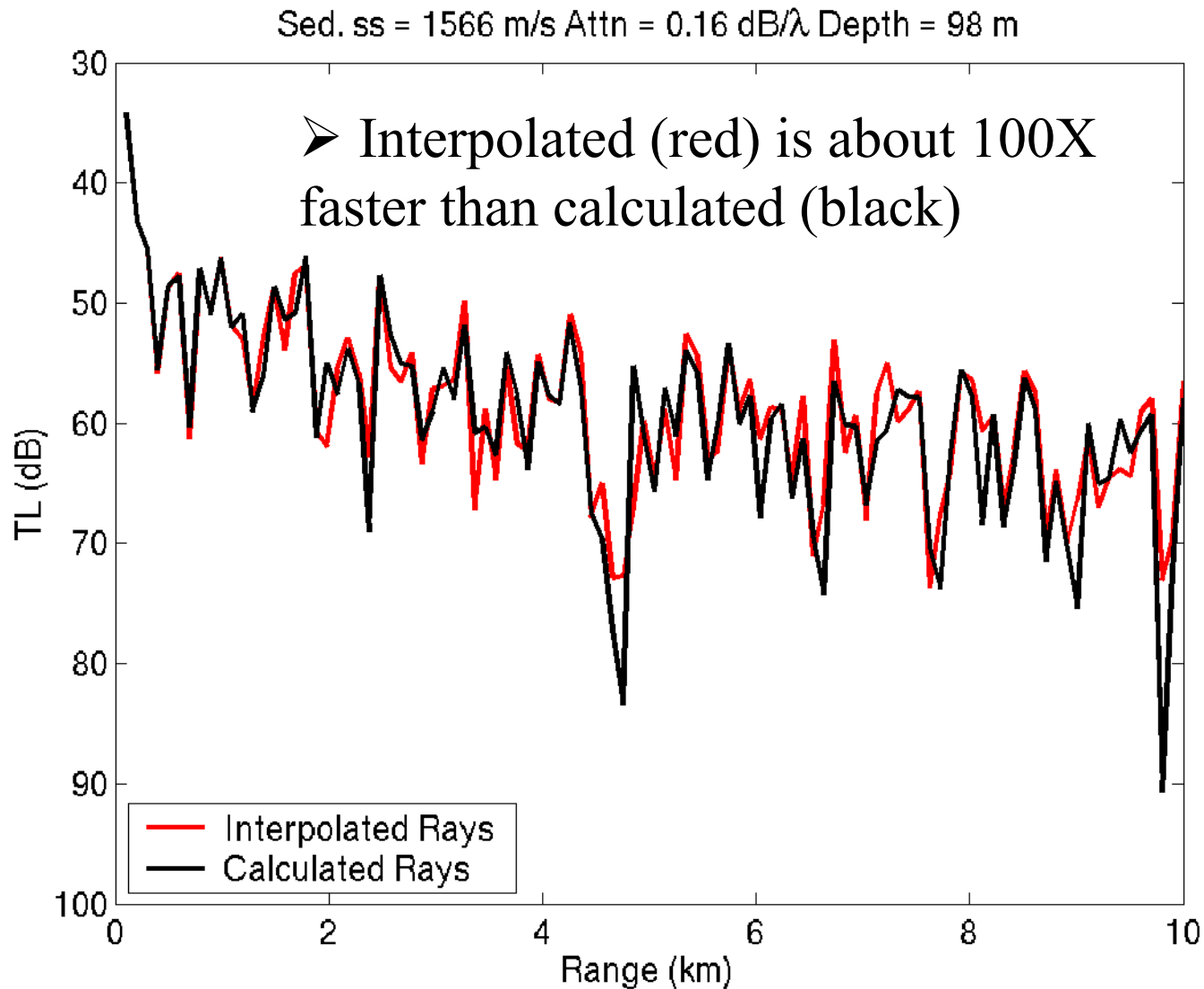
Sed. SS

Atten.

Depth

1525 m/s 0.1 dB/λ 98 m

Does it work? TL example



Advantage: very fast and broadband